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How knowledge spillover contributes to economic growth in metro areas

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Media often report on which cities are the "best" for a particular demographic—recent graduates, entrepreneurs, working women, and so on. These studies tend to use labor market data, such as employment and unemployment figures, industry concentration, wages, and educational levels, to support the findings. Reports about booming metropolitan areas garner interest from local residents, policymakers, and people considering a move to a new city for better opportunities.

Have you wondered why certain cities thrive as business hubs or innovation centers? In "New ideas in the air: cities and economic growth" (Federal Reserve Bank of Philadelphia *Business Review*, fourth quarter 2014), author Gerald A. Carlino suggests education and "knowledge spillovers" are the drivers for economic growth in metropolitan areas. He examines U.S. productivity—output per hour worked—over the past century to explore the knowledge spillover idea. Economist Robert Solow calculated that from 1909 to 1949, technological progress accounted for the bulk of output growth—51 percent—and growth in capital stock accounted for 11 percent. While this may not be a surprise, these findings show that U.S. productivity growth is driven by technological progress. Later economists expanded on Solow's framework by focusing on the knowledge and skills of workers as catalysts to greater output. The idea of human capital as a component of productivity growth is one of the main ideas behind knowledge spillover; increases in human capital lead to more efficient workers, new goods, and innovative production processes.

Naturally, those who are educated and influential contribute to knowledge spillover, whether this is intentional or not. Carlino states, "This is especially true for 'tacit' knowledge, which is highly contextual and hard to codify," meaning that the knowledge spilled isn't necessarily learned from a textbook or new source; regular face-to-face contact is best. Therefore, that knowledge spillover and innovation occurs in cities is simple to understand but not simple to measure.

Within the human capital framework espoused by economists Paul Romer and Robert Lucas, Carlino observes that education level can be used to measure human capital in cities. College share (the percentage of the adult population ages 25 and over with college degrees) among metro areas with 200,000 residents ages 25 and older ranged between about 9 percent and 28 percent in 2010. If the areas with high college-share percentages have more knowledge spillover and innovation as the result of a highly educated population, one would observe that wages are higher, too. Various studies show that "each additional year of average education increases a region's expected wages by 1 percent to 5 percent."

A study by Antonio Ciccone and Giovanni Peri revealed that the productivity of highly skilled workers had a positive effect on the productivity of less-skilled workers in the same area. Also, a study by Enrico Moretti found that as a city's college share increased by 1 percent, wages for college graduates increased by 0.5 percent, high school dropouts' wages rose 2 percent, and wages of high school graduates went up 4.5 percent. Hence, the existence of highly skilled workers in a metro area appears to benefit less-skilled workers in terms of wage growth.

While wage growth is an indicator of economic growth, it does not explain how innovation causes economic growth in cities. Knowledge spillover in cities can be measured by patent activity—this and college share in the 1990s were studied by Carlino, Satyajit Chatterjee, and Robert Hunt. They found that a 10-percent increase in college share was connected with an 8.6-percent increase in patents per capita. Patent citations are a nod within the patent application to prior, related patents and can indicate the level of knowledge flow in an area if inventors cite patents from the same metropolitan area. Another study, this one of advertising agencies in Manhattan by Mohammad Arzaghi and Vernon Henderson, found that knowledge spillover is decidedly localized.

Carlino acknowledges that relating patent activity to knowledge spillover has issues: inventors may choose not to patent their products; firms may rely on trade secrets in place of patents to protect intellectual property; and patent examiners may add patent citations; all of these counter the idea that knowledge flows among local inventors. Still, one can look at patent interferences, which occur when multiple applicants apply for a patent with the same invention. In a study by Jeff Lin, patent interferences were more likely to occur between inventors in the same area than between those far apart —more proof that knowledge is shared among local inventors.

Although studies on wage, education, and patent activity provide evidence that knowledge spillover is present within cities, no solid evidence exists that shows exactly *how* knowledge spillover happens. One hypothesis is that young workers move to cities that included experienced professionals so that they, too, can become successful in a particular industry or field. Another idea suggests that changing jobs leads to knowledge flow within similar firms. However, firms may require workers to sign contracts with nondisclosure or noncompete clauses to prevent mobile workers from sharing exclusive information with competing firms. Carlino closes by encouraging policymakers to support legislature that increases human capital, especially education, as his studies show that this is the largest factor that contributes to technological and economic growth in cities.